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Distribution of Gastropods in a Mangrove Habitat in South-East Queensland

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ABSTRACT

A mangrove forest at Wellington Point (south-east Queensland) was sampled between February and September 1978 for information on distribution and abundance of gastropod molluscs. Thirty species of gastropod were collected. The mangal could be divided into zones determined by floral species. Greatest variety of gastropods was recorded from the central *Avicennia* swamp and seaward edge zones. Variety declined in the *Rhizophora* and upshore zones. The highest population recorded was for juvenile *Salinator fragilis* (3,000 individuals per m^2) on the *Suaeda* salt flat.

INTRODUCTION

Investigations of the fauna of Australian mangrove forests (eg. MacNae, 1966, 1967; Hegerl and Davie, 1977; Hutchings and Recher, 1974; Saenger *et al.*, 1977; Wells, 1983) and of mangals overseas (eg. MacNae, 1963; MacNae and Kalk, 1962; Berry, 1963; Walsh, 1967; Sasekumar, 1974) indicate that gastropod molluscs are a major component of mangrove faunas. Despite this numerical importance of gastropods, few papers deal at length with molluscan mangrove faunas (Berry, 1963, 1975; Coomans, 1969; Brown, 1971; Vermeij, 1973; Wells, 1980, 1984; Wells and Slack-Smith, 1981).

This paper describes the distribution of gastropods inhabiting a mangrove forest and adjacent habitats at Wellington Point, south-east Queensland.

STUDY AREA

Wellington Point is a small promontory (27° 28'S., 153° 14'E.) on the western side of Moreton Bay, south-east Queensland. The headland is approximately 10 km south of the mouth of the

Brisbane River and 20 km north of the mouth of the Logan-Albert River system.

The intertidal sand and mud flats on the eastern side of Wellington Point support extensive growths of eelgrass (*Zostera capricorni* Aschers) interspersed with a sand spit connecting with King Island, mud-sand expanses, rubble areas, and, near low tide level, a zone of sponges, soft corals and hard corals. Mangroves fringe King Island and southern shores of the Wellington Point headland. Salt marsh plants occur in places in a narrow band upshore of the mangal.

The abiotic environment of Moreton Bay is described by Vohra (1965), Stephenson (1968), Newell (1971), Hailstone (1972) and Greenwood (1973).

Coastal air temperatures recorded near Wellington Point have monthly means ranging between 7.8°C and 26.6°C (extended range 2.8°C and 30.7°C), with December the warmest month and July the coldest. Western shores of Moreton Bay have a mean insolation of 7.5 hours per day. The period from July to September experiences minimal cloud cover (mean of 12.6 clear days per month) while November to March experiences maximal cloud cover (mean of 3.9 clear days per month).

Wellington Point receives a mean rainfall of 1200 mm per year. January is the wettest month (mean of 150 mm) while August is the driest (mean of 30 mm). Approximately 66.6% of annual rainfall occurs between October and March. Humidity varies little about a daily mean of 75% throughout the year.

Seawater surface temperatures in the area range between 14.8°C in July to 27.1°C in February. Salinities are usually lowest in the period from January to March coincident with the heaviest precipitation and river run-off and range from approximately 30.0‰ to 36.5‰. Tidal movements show a mean high water spring tide level of 1.8 m above datum, a mean high water neap tide level of 1.4 m above datum and a mean sea level of 1.0 m above datum.

Wellington Point may be summarised as a subtropical, semi-sheltered, primarily soft bottomed marine environment with heaviest rainfall in summer.

MATERIALS AND METHODS

Sampling was carried out along three transect lines selected to incorporate possible cross-shore and along-shore gradients within the mangal. Systematic sampling was employed along each transect with sampling sites spaced at 20 m intervals. Sites were sampled on four occasions at intervals of approximately two months between 21 February and 4 September in 1978. Constraints on time precluded a complete annual study. All samples were taken during afternoon ebb tides.

At each site, substrate epifauna was counted within three 1.0 m quadrats and averaged to obtain an estimate of numbers of gastropods per m^2. Where very numerous small gastropods were present (eg. *Salinator solida* and *S. fragilis* juveniles), individuals were counted within a 0.1 m^2 quadrat placed in the centre of the 1.0 m^2 quadrats.

Pneumatophore epifauna comprises those gastropods found on the pneumatophores or amongst the epiphytic algae on the pneumatophores. The number of gastropods on 50 pneumatophores was counted at each site and the mean number calculated per pneumatophore. This mean was multiplied by the mean number of pneumatophores within the 1.0 m^2 quadrats to obtain an estimate of pneumatophore epifaunal density.

Mangrove tree epifauna is that present on prop-roots, trunks, branches and leaves of trees. The number of gastropods on six trees closest to the sampling site was counted and the mean number per tree calculated. The number of trees per m^2 was estimated from the area occupied by 10 trees closest to the sampling site. The density of tree epifauna at each site was estimated by multiplying the mean number of gastropods per tree by the number of trees per m^2. The vertical distance from the substrate at which species most commonly occurred was recorded

Dead logs found at or near sampling sites were split and examined qualitatively for gastropods. Samples of sediment and algae on the sediment were returned to the laboratory for sieving and qualitative extraction of gastropods. No quantitative sampling of infauna was attempted. Other workers (eg. Brown, 1971; Sasekumar, 1974; Wells and Slack-Smith, 1981; Wells, 1984) have found very few infaunal molluscs in mangrove forests. Gastropods of the family Onchidiidae display tidal burrowing behaviour and were not included in this study.

Samples were taken of dominant vegetation species including algae for identification. Sediment characteristics were qualitatively assessed by eye in the field.

Profile diagrams of the transects were constructed using calibrated rods and sighting to the horizon. Heights of small mangrove trees were measured; heights of trees over 2.5 m were estimated. Tidal levels of sampling sites were estimated by noting times at which flooding tides reached each site and comparing these times with tidal curves constructed from information in the "Official Tide Tables of the Department of Harbours and Marine, Queensland". Shore profiles including tree heights and tidal levels are illustrated in Figure 1. A profile of the nearby clearing is included for reference.

Samples of snails were returned to the laboratory and shell length (apex to anterior margin of columella) measured with vernier calipers to the nearest 0.1 mm. Samples of sediment and algae were sieved through 1.0 mm standard Endecott sieves with running tap water and retained gastropods were hand-sorted and, if large enough, measured with vernier calipers. Gastropod specimens were preserved in 5% formalin solution.

RESULTS

Thirty species of gastropod were collected. The species are listed in Table 1 together with the habitats in which each species was found and an indication of abundance averaged over sampling times and transects. The ranges of abundance are essentially logarithmic and are intended to indicate broad distributional patterns rather than any minor variation in numbers between sampling times and transects. Where major differences in abundance of species occurred between times or transects, mention is made in the text. The mangal could be divided into six floral zones which are discussed below.

Sporobolus-Juncus saltmarsh zone (I)

Saltmarsh plants occurred on the upshore edge of the intertidal flat and extended slightly up the embankment to be replaced by terrestrial flora. Dominant saltmarsh plants were *Sporobolus virginicus, Juncus maritimus* and *Suaeda australis,* with some terrestrial species eg. *Eucalyptus* spp. A few scattered seedlings of *Avicennia marina* also occurred in the zone. The sediment was predominantly red terrestrial clay with pebbles. Some very shallow water channels drained the zone.

Three species of *Ophicardelus* : *O. sulcatus, O. quoyi* and *O. ornatus,* co-inhabited this zone. *Ophicardelus sulcatus* occurred in densities of up to 40 individuals per m^2 and *O. quoyi* up to 30 specimens per m^2, while only two specimens of *O. ornatus* were recorded in July. This was the only zone in which *Ophicardelus* species were collected.

Melosidula zonata was found amongst saltmarsh vegetation in densities to 52 individuals per m^2. *Salinator solida,* including large specimens of greater than 8.0 mm shell length, occurred in numbers of up to 130 per m^2.

All saltmarsh gastropods were found predominantly on the sediment though some specimens of the ellobiids were attached to leaves of *Juncus* several centimetres above the sediment surface. Gastropods were most common beneath *Zostera* debris at extreme high water mark.

Salt flat zone (II)

A salt flat, 15 to 50 m wide, occurred downshore of the saltmarsh vegetation. A shallow channel drained the upshore margin of the flat but most of the zone was slightly raised and drier than the adjacent zones. Sparse *Suaeda australis* was the only macrophyte present and blue-green algae coated the sediment in places. The sediment was similar to that of the saltmarsh.

This zone was exposed to the atmosphere at most of the sampling times and supported the lowest diversity of gastropods with only five species collected. *Salinator fragilis* occurred in densities of up to 910 specimens per m^2. *Salinator* juveniles (tentatively identified as *S. fragilis*) of less than 1.0 mm shell length were present in July and September in densities exceeding 3,000 individuals per m^2.

Cerithidea largillierti was present in the zone in densities up to 12 per m^2 where a thin layer of water remained over the sediment.

Small *Avicennia* zone (III)

A distinct 3,000 m^2 triangle of small ($<$2 m tall) *Avicennia marina* saplings and seedlings occurred on the southern edge of the mangrove forest adjacent to the clearing. These small trees probably represent regrowth after a past clearing. The sediment was a red-grey mud, probably a mixture of upshore terrigenous input and sediments deposited from coastal rivers. Shallow channels and pools ($<$1 cm deep) persisted in the zone at low tide.

The most obvious gastropod in the zone was *Cerithidea largillierti*, occurring on the sediment in densities of up to 17 individuals per m^2, especially where the substrate was moist. Other dominant species were *Salinator solida* and *S. fragilis* on the sediment and *Melosidula zonata* on and near bases of the seedlings. Small specimens of *Bembicium auratum* and *Littorina scabra* were present on the sediment and on pneumatophores and tree stems.

Central *Avicennia* swamp (IV)

Avicennia marina trees ranging in height from 2 to 4 m formed the largest zone in the mangal. Dense growths of algae, especially *Bostrychia* sp., were epiphytic on pneumatophores. The sediment comprised a dark brown mud and was coated with a layer of shed *Avicennia* leaves. Water to a depth of 5 cm covered more than 50% of the sediment at low tide.

Salinator solida was the dominant gastropod in the central swamp of the forest with densities of up to 800 individuals per m^2. All specimens collected in the mangal proper were smaller than 8.0 mm shell length. *Salinator fragilis* occurred in much lower numbers, usually fewer than 10 specimens per m^2. Where the upshore boundary of the forest was distinct (transect C), *S. solida* suddenly replaced *S. fragilis* as the dominant species amongst the trees.

Melosidula zonata was present in numbers up to 140 per m^2 and was associated mostly with the algal growths on pneumatophores. Tree-living gastropods were more common than in the small *Avicennia* zone. *Bembicium auratum* occurred in densities of up to 18 per m^2 along transect A near the clearing but in considerably lower numbers (up to 3 per m^2) in the centre of the mangal.

***Rhizophora* zone (V)**

Rhizophora stylosa ranging from saplings to 5 m tall trees formed a central belt up to 80 m wide. Specimens of *Avicennia* also occurred throughout this zone, though the belt was nearly monospecific for *Rhizophora* on transect C. The sediment was a fine, dark brown mud, waterlogged and with shallow pools common. Some *Bostrychia* occurred low on the prop-roots of *Rhizophora* and on *Avicennia* pneumatophores.

Nerita planospira was the most obvious species in this zone, attached to the prop-roots of *Rhizophora* and lower trunks of *Avicennia* from close to sediment level to 0.5 m above it. Juvenile specimens of *Salinator solida* and *S. fragilis* were associated with the leaf litter on the sediment surface but were less common than farther upshore. *Melosidula zonata* was much less common than in the upshore *Avicennia* zones, occurring on the outer surface of mud clogged epiphytic algal growths. Juvenile potamidids (*Pyrazus ebeninus, Velacumantus australis*) were associated with algal clumps on the surface of the sediment.

Seaward fringe (VI)

Tall *Avicennia marina* trees, up to 7 m in height, formed the seaward boundary of the forest. Very scattered *Rhizophora stylosa* also occurred in the zone. Pneumatophores and tree bases were coated with a thick growth of epiphytic algae, especially *Catenella* spp. Sediment comprised a fine, dark brown rather boggy mud. Shallow pools and channels were confluent with those of the mudflat downshore.

Gastropod diversity increased as the *Rhizophora* was replaced by large *Avicennia* trees. Juveniles of the potamidids, *P. ebeninus* and *V. australis,* were very common amongst algal mats on the sediment surface in densities of up to 310 and 550 individuals per m^2 respectively in July. The cerithiid *Cerithium* sp. A occurred in densities of up to 300 specimens per m^2.

Tree-living gastropods were most obvious in this zone. *Bembicium auratum* occurred in densities of up to 38 per m^2 especially on pneumatophores and tree trunks, seldom higher than 1.5 m above the sediment. Small specimens usually were associated with algal growths on pneumatophores. *Littorina scabra* was less abundant than in the central swamp of the forest but was obvious on tree trunks, often clumping in crevices. *Cerithidea obtusa* was uncommon in the seaward fringe, usually occurring higher above the sediment than *B. auratum* and *L. scabra. Nerita planospira* was less common than in the *Rhizophora* zone.

Downshore mud flat

Flats of fine dark brown mud, with areas of sandy mud, extended downshore beyond low water mark from the mangal. A few *Avicennia* seedlings were present but the mudflat was predominantly covered by *Zostera capricorni.* No systematic quadrat sampling was carried out on the flat but large potamidids *(Pyrazus ebeninus* and *Velacumantus australis)* were conspicuous on the sediment amongst the *Zostera.* Large adults of *P. ebeninus* were common, in contrast to the mangal where only juveniles were collected. Large specimens of *Bembicium auratum* also occurred on the sediment.

Zonation of gastropods

The two species of *Salinator* were dominant or codominant in the upshore zones I to IV. *Salinator fragilis* was extremely abundant where vegetation was sparse or absent and *S. solida* largely replaced it in the mangal proper and amongst upshore saltmarsh vegetation.

The three species of *Ophicardelus* were restricted to the saltmarsh vegetation zone. *Melosidula zonata* displayed less distinct zonation, occurring in all zones upshore of zone VI except the salt flat.

Littorina scabra and *Bembicium auratum* occurred amongst epiphytic algae near the sediment and on trees at various heights. Both species were present only in floral zones supporting mangrove trees. There was some evidence of vertical zonation on trees in the seaward fringe zone with *B. auratum* within 1.5 m of the tree bases, *L. scabra* from 0.5 to 2.0 m (rarely 5.0 m) above the sediment and *Cerithidea obtusa* from tree bases to 3.5 m above the sediment. Migration of gastropods up and down trunks of mangrove trees has been recorded (eg. Berry, 1975) and the above heights of attachment might vary seasonally or diurnally.

Average height of attachment for *C. obtusa* and *L. scabra* increased toward the seaward edge at Wellington Point. The population of epifaunal gastropods on trees was highest in the seaward fringe as noted by Berry (1975) in Malaysia.

Most specimens of *L. scabra* in the upshore zones III and IV were associated with algae epiphytic on pneumatophores or on tree bases, while near the seaward edge most specimens were attached to trees at heights noted above. This variation in attachment height probably reflects the degree of tidal immersion at different levels of the mangal.

Juvenile potamidids and the small *Cerithium* sp. A were closely associated with algal mats on the sediment surface, best developed in the moist downshore floral zones.

Nerita species were found only in the *Rhizophora* and seaward fringe zones. *Nerita planospira* was the most conspicuous gastropod in the *Rhizophora* zone but was less common downshore.

DISCUSSION

The 30 species recorded in this study represent one of the highest diversities of gastropods recorded for a mangrove forest anywhere in the world. Berry (1963) in Singapore and Sasekumar (1974) at Port Swettenham in Malaysia noted 19 and 25 species respectively. The mangrove forests of south-east Africa (at a similar latitude to Moreton Bay) appear to be considerably poorer in species variety. MacNae and Kalk (1962) recorded seven species for Inhaca Island and MacNae (1963) noted nine species for a forest in South Africa. Brown (1971) stated that of the 13 species of gastropods found in South African mangals, ten were represented at the Umgeni River, making it the richest assemblage for that region. Very small species were not mentioned in these studies.

MacNae (1966) noted 17 species of gastropods for mangals of east and south Australia, but in light of more recent studies this is obviously an incomplete list. Wells and Slack-Smith (1981) collected 14 gastropod species from a mangal in Admiralty Gulf in the Kimberley region of north-western Australia. Hegerl and Timmins (1973) recorded 20 species from Noosa wetlands, Hegerl and Tarte (1974) recorded 21 species from wetlands near Rockhampton, and Graham *et al.* (1975) noted 38 species from wetlands near Cairns. The latter two studies included onchidiid species. Hutchings and Recher (1982) listed 98 species of non-onchidiid mangrove gastropods in Australia, including 51 species from south Queensland.

It is likely that more detailed study of microgastropods will increase the numbers of recorded species at most or all of the above sites and the apparently high diversity at Wellington Point may be due largely to omission of very small species from other studies. Of the 30 species noted at Wellington Point, approximately 20 may be regarded as reasonably common macrogastropods and it is this number that gives a better indication of variety relative to other mangrove studies. Wells and Slack-Smith (1981) and Wells (1984) failed to find microgastropods in mangals of north-west Australia. The significance of this difference from the Wellington Point mangal requires ellucidation.

The familial composition of the gastropod fauna at Wellington Point concurs with the observations of MacNae (1968) and the resumé of Hutchings and Recher (1982:96) for mangals elsewhere in Australia though the family Amphibolidae is dominant in terms of numbers of individuals at Wellington Point.

Recorded densities of mangrove gastropods vary greatly between studies. Golley (1960) and Golley *et al.* (1962) observed densities of 54 per m^2 and 31 m^2 respectively for the ellobiid *Melampus coffeus* at Puerto Rico. Berry (1963) noted densities of over 2,000 per m^2 for *Assiminea breoccula* in a Singapore mangal and Brown (1971) recorded *Assiminea bifasciata* in South Africa at 370 per m^2. In Australia, Ewers (1963) recorded *Velacumantus australis* in densities of 600 per m^2 on New South Wales tidal flats and Vohra (1965) described populations of newly recruited *Pyrazus ebeninus* in excess of 1,000 individuals per 15 cm x 15 cm sediment surface in Moreton Bay. Hutchings *et al.* (1977) recorded 0.4 individuals per m^2 for *Littorina scabra,* much lower than numbers observed at Wellington Point, and 55.5 per m^2 for *Tatea* sp. at Brooklyn on the Hawkesbury River. Hutchings and Recher (1982) noted that *Tatea* may exceed 10,000 individuals per m^2 on the edge of mangroves. Wells and Slack-Smith (1981) found rather low densities of molluscs, primarily gastropods, in a mangal in the Kimberleys of Western Australia with a maximum total density of 3.2 per m^2. In addition to high diversity, Wellington Point showed high densities of gastropods. The greatest density was for very small *Salinator* juveniles (probably *S. fragilis)* on the sediment of the upshore salt flat. Here numbers exceeded 3,000 per m^2 in September. Within the mangal proper, juveniles of *S. solida* occurred in densities of up to 800 per m^2 in July. *Velacumantus australis* juveniles were sampled in densities of 550 per m^2 amongst the sediment algae of the seaward fringe zone in July.

Faunal zonation in mangrove forests has been described by many workers eg. Golley (1960), Golley *et al.* (1962), MacNae (1963, 1966, 1967, 1968), MacNae and Kalk (1962), Berry (1963, 1972, 1975), Walsh (1967), Coomans (1969), Brown (1971), and Sasekumar (1974). The present study indicates a faunal zonation in and about the Wellington Point mangal but with broad and overlapping ranges for many species. MacNae and Kalk (1962), MacNae (1966, 1967, 1968) and Wells and Slack-Smith (1981) correlated faunal zonation with that of mangrove tree species. Though only two species of mangroves were present in the Wellington Point forest, six zones were recognisable on the basis of floral characteristics and gastropod distributions could be related to these zones of vegetation.

Vertical zonation on trees was not obvious in the Wellington Point mangal and was most apparent in the seaward fringe zone where tree-living gastropods were most common. More obvious vertical zonation may be expected where several species of one genus are present on the same trees as was noted for species of *Littorina* and *Cerithidea* by Berry (1963) and MacNae (1968).

A high density of gastropods (particularly pulmonates) was observed in the upshore saltmarsh amongst *Sporobolus* and *Juncus*. Considerable quantities of debris, especially *Zostera* leaves from downshore mudflats, accumulated at these high tidal levels and retained moisture between spring tide floodings. MacNae and Kalk (1962) noted a paucity of gastropod fauna in the comparable upshore region at Inhaca Island (Africa), attributing this to a lack of debris at the high water level and the consequent drying effects.

Progressive upshore replacement of prosobranchs by air-breathing pulmonates was noted by Berry (1963, 1975), Sasekumar (1974) and other workers. At Wellington Point, the pulmonate amphibolids and ellobiids were present in much higher densities than were the prosobranch species farther downshore, with the exception of scattered high concentrations of juvenile potamidids and cerithiids in the seaward edge zone. The low densities of prosobranchs may relate in part to their generally being larger than the pulmonate species.

The lowest diversity of gastropods was recorded for the open salt flat zone between the upshore saltmarsh plants and *Avicennia* saplings. This was probably a direct result of the lack of moisture during extended periods of emersion and high stress due to exposure to the sun.

There were several examples of habitat partitioning between similar or closely related species of gastropod. *Salinator solida* and *S. fragilis, Cerithidea obtusa* and *C. largillierti*, and *Haminoea* sp. A and *H.* sp. B utilised quite different habitats at Wellington Point (Table 1). No habitat differences could be discerned for the species of *Ophicardelus*.

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TABLE 1: Gastropod distributions and habitat preferences.

Floral zones (I-VI) as in text. Abundances averaged over four sample times: X — present ($<10/m^2$), XX — common ($\geq 10/m^2$), XXX — abundant ($\geq 100/m^2$). Habitat (Ha): 1 — substrate epifauna, 2 — saltmarsh plant epifauna, 3 — pneumatophore epifauna, 4 — lower mangrove epifauna (roots and trunks), 5 — upper mangrove epifauna (branches and leaves), 6 — log infauna.

Class Gastropoda	I	II	III	IV	V	VI	Ha
Subclass Prosobranchia							
Order Archaeogastropoda							
Family Neritidae							
Nerita planospira (Anton, 1839)					X	X	4
Nerita chamaeleon Linné, 1758						X	13
Nerita lineata Gmelin, 1791					X	X	4
Family Trochidae							
Austrocochlea constricta (Lamarck, 1822)						X	34
Prothalotia comtessei (Iredale, 1931)						X	1
Order Mesogastropoda							
Family Littorinidae							
Littorina scabra (Linné, 1758)			X	XX	X	X	3456
Bembicium auratum (Quoy and Gaimard, 1834)			X	XX	X	XX	1346
Family Potamididae							
Cerithidea largillierti (Philippi, 1851)		XX	XX	X	X	X	1
Cerithidea obtusa Lamarck, 1822			X	X	X	X	45
Pyrazus ebeninus (Bruguière, 1792)				XX	X	XXX	13
Velacumantus australis (Quoy and Gaimard, 1834)				XX	XX	XXX	13
Family Cerithiidae							
Cerithium sp. A (cf. *Cerithium tenellum* Sowerby, 1855)						XXX	13
Cerithium sp. B (cf. *Clypeomorus monoliferus* Keiner, 1841)						X	1
Family Stenothyridae							
Stenothyra australis (Hedley, 1901)				X		X	3
Family Assimineidae							
Assiminea relata (Cotton, 1942)	X	X					12
Family Rissoidae							
Merelina goliath (Laseron, 1950)			X	X	X		13
Family Rissionidae							
Unidentified sp.				X			3
Family Hydrobiidae							
Hydrobia buccinoides (Quoy and Gaimard, 1834)						X	1
Family Vitrinellidae							
Unidentified sp.				X		X	3
Order Neogastropoda							
Family Nassariidae							
Nassarius burchardi (Philippi, 1849)						X	1
Family Architectonicidae							
Unidentified sp.				X			3
Subclass Opisthobranchia							
Order Cephalaspidea							
Family Atyidae							
Haminoea sp. A	X	X					1
Haminoea sp. B			X	X	X	X	1

Subclass Pulmonata							
Order Basommatophora							
Family Amphibolidae							
Salinator solida (von Martens, 1878)	XX	X	XX	XXX	XX	X	13
Salinator fragilis (Lamarck, 1822)		XXX	XX	X	X		1
Family Ellobiidae							
Melosidula zonata (H. and A. Adams, 1854)	XX		XX	XX	X		1236
Cassidula nucleus (Gmelin, 1791)				X	X	X	4
Ophicardelus sulcatus (H. and A. Adams, 1854)	XX						12
Ophicardelus quoyi (H. and A. Adams, 1854)	XX						12
Ophicardelus ornatus (Ferussac, 1821)	X						12

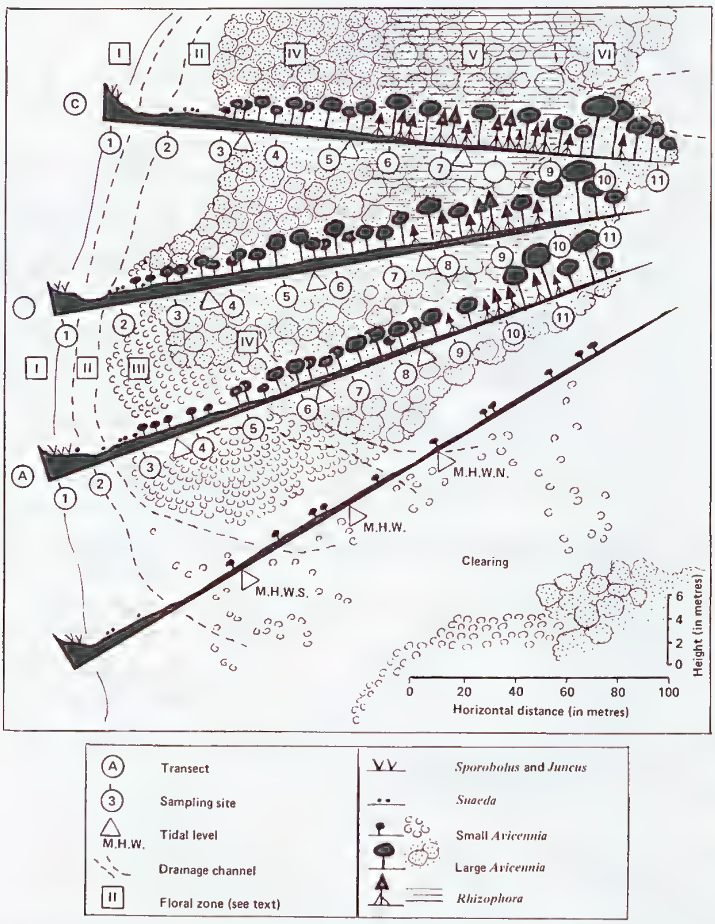

Fig.1 — Silhouette profiles of transects superimposed on a plan view of the sampling area at Wellington Point.